

TREATMENT AND PACKAGING OF PRE-PEELED POTATOES¹R. H. TREADWAY AND R. L. OLSON²

Potatoes are no exception in the general trend toward increased merchandising of fruits and vegetables in pre-packaged form. Small packs put up in transparent film bags and in paper sacks with cellophane "windows" are in popular demand. Newer still are dry packs of uncooked peeled potatoes. Although pre-peeled potatoes have not yet become a regular item in retail markets, their use for institutions is well established. Use of foodstuffs ready for cooking is an important factor in streamlining methods of operation.

Pre-peeled potatoes were first produced for the restaurant trade more than 20 years ago. The potatoes were delivered in metal containers in which they were immersed in water or salt solution. Distribution of peeled potatoes in dry-pack form was started in or about 1936. After the close of World War II, the industry spread rapidly until nearly all metropolitan centers of the country had one or more processors. It has been difficult or impossible to collect accurate statistics concerning the industry because there have been frequent changes. It is not unusual, however, for any new industry to have a number of failures. There are indications at present, that the industry has become stabilized and that the better processors have survived the introductory phase.

It is estimated that 1½ to 2 million bushels of potatoes are used annually by the pre-peeled potato industry. A few of the largest processors reportedly produce about 250,000 pounds of finished product per week during peak periods. Several process 60,000 to 80,000 pounds weekly. Smaller processors turn out 15,000 to 20,000 pounds of product a week.

Restaurateurs find it good business to pay 4 to 6 cents a pound above the price of unpeeled potatoes for the pre-peeled product because they (a) save labor and purchase of equipment; (b) save storage space; (c) reduce the amount of garbage handled; (d) have peeled potatoes always available, particularly French-fry slices; (e) pay for their peeling loss in advance and thereby know what it is; (f) have potatoes of better quality than ordinary unpeeled potatoes; (g) purchase potatoes at a more stable price throughout the year than is possible in the ordinary market, which fluctuates from day to day.

Raw Material

It is advantageous, perhaps essential, for the pre-peeler to have well rounded experience in the marketing and handling of potatoes. Processing costs (peeling and trimming losses, labor expense, and wastage from rot) are related to the quality of potato. Therefore, the cost of processing a second-grade potato may be such that the initial price savings over top-

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quality raw material cannot be justified. Careful analysis of cost factors that may be affected by the quality of potatoes purchased (tuber size, depth of eyes, uniformity of size and shape, and freedom from rot and mechanical damage) must be made to determine an advantageous price to be paid for any given lot of potatoes. Furthermore, the cooking quality of an available supply of potatoes should be known before a purchase is made. The simplest method is to sample potatoes from several sacks and cook them to see if they will conform to the needs of the ultimate consumer. Of particular importance is the tendency of some potatoes to darken on French frying. Frequently, if potatoes have been in cold storage for an extended period, they tend to have a high reducing sugar content which will cause an unduly dark product when they are fried. Warm storage (70° F.) for a period varying from 2 to 3 weeks will usually convert excess reducing sugar to starch and remedy the situation. The risk to the pre-peeler must be calculated with due regard to costs and other supplies that may be available. In short, the pre-peeler must become a purchasing agent, seeking an optimum price and quality of raw material for his customers. This is a part of the service he sells along with the product.

Final preparation of the raw material before peeling will frequently include thorough washing to remove dirt although in many cases the potatoes are fed into mechanical peelers in the condition in which they are purchased. Compartmented, trough washers of the type manufactured for users of potatoes in the food processing and starch industries are used.

Peeling

Substantially, the economy of the pre-peeled potato industry is based on the fact that peeling waste is less in a central peeling plant than in small operations. Hand paring is extremely wasteful. Losses in small-scale peeling, even with mechanical equipment run as high as 40 per cent, as compared with perhaps 20-25 per cent in a central peeling plant.

Three types of peeling — steam, lye, and abrasion — are employed in central peeling plants. In the steam and lye methods, the skin is loosened by the treatment and then removed by a light mechanical rubbing action while jets of high-pressure water play on the potatoes. In abrasion peeling, the skin is ground away as the potatoes come in contact with rough surfaces while being tumbled in a drum. Regardless of the peeling method, the remaining bits of skin and dark spots are removed by hand trimming as the potatoes move along an inspection table.

It is likely that the advantages and disadvantages of these three methods of peeling make one about as good as another. Some large operators feel that steam and lye peeling are more economical than abrasion, since they remove less of the tissue underneath the skin. Mazzola (2) reported that a survey of large processors of potatoes (in dehydrating and canning, primarily) showed that the least loss is entailed in high-temperature lye peeling. Batch steam peeling resulted in greater loss, and abrasion peeling caused the greatest loss. Various factors, however, may change these relationships in certain instances. The original investment for equipment is usually higher for steam and lye peeling than for abrasion peeling.

High-temperature operations (steam and lye) must be closely controlled to avoid cooking the potato tissue to excessive depth. This would be unobjectionable in potatoes that are to be cooked immediately in a food processing plant, but a cooked surface is undesirable in a product to be merchandised as raw, pre-peeled potatoes.

Varietal characteristics are such that some potatoes (notably, the White Rose variety) cannot be used for mashed potatoes following high-temperature peeling and a few days' storage. The cooked layer becomes so tough that it will not break up in mashing operations and leaves undesirable lumps. Replacement of expensive equipment and even business failure have resulted from the difficulties of maintaining a high-quality peeled potato with high-temperature peeling methods.

In lye peeling, operations must also be so controlled to leave no perceptible alkali after the peeled potatoes are washed. Various types of potato discoloration, sometimes accompanying lye peeling, constitute still another problem.

Although peeling losses in abrasion peeling are frequently large, this method is usually preferred by smaller processors because the equipment is not only less expensive but more nearly foolproof. Wright and Whiteman (4) showed that processors can avoid much waste by selecting proper varieties from the best sources and properly timing the operation of their peelers. Choosing potatoes that are uniform in size, as well as having a minimum amount of cavities and depressions, is particularly important in abrasion peeling. Potatoes with deep eyes must either be left in the peeler until the skin is removed from the low spots or be subjected to extensive hand trimming. Wright and Whiteman found that the best stock lost 14-20 per cent of its weight in 2 minutes of abrasion peeling. Potatoes least desirable because of shape and irregular surface lost 25-37 per cent under the same conditions.

Treatments

Upon exposure to air, raw, peeled potatoes quickly turn reddish-brown and finally dark grey or black. This discoloration is caused by the action of an enzyme system, which in the presence of oxygen, catalyzes the oxidation of certain substances in potato juice to form a series of colored compounds. A solution of a bisulfite salt or of sulfur dioxide inhibits the action of this enzyme system and also counteracts by its reducing action the formation of the colored compounds.

A short dip in a dilute solution of the treating agent preserves the original whiteness of peeled potatoes. It is impossible to give optimum conditions of treatment, because differences in raw material, processing equipment, operating methods, packaging material, and storage practices affect the results. The following directions, however, will serve as a guide: Dip for 30 seconds in a solution of 0.5 per cent sodium bisulfite and 0.5 per cent citric acid (3). Such a mixture of bisulfite and acid in water gives sulfur dioxide. A longer dipping time or a stronger solution, particularly with respect to the bisulfite strengthens the preservative action, but over-treatment may cause off-flavor in the product. Excessive acid may cause juice to leak from the potatoes.

The potatoes are usually graded for size at some stage prior to the color-stabilizing treatment. Small potatoes are treated whole for later use

in boiling, mashing, or roasting. Large potatoes are sliced for frying. It is estimated that two-thirds to three-fourths of the over-all production of pre-peeled potatoes is in French-fry slices. Processors sell the sliced potatoes at the same price or slightly above that of whole potatoes.

Stronger treatment is required for whole potatoes than for sliced potatoes. One processor found that his unsliced potatoes absorbed only about one-fifth as much sulfur dioxide as slices under identical treatment. There is a wide range in the residual sulfur dioxide content of pre-peeled potatoes, based on information received from various processors and on our determinations. The product should have at least 70 to 100 parts per million of sulfur dioxide for adequate protection against discoloration. A residual sulfur dioxide content of 140-150 parts per million will permit a greater safety factor. Some of the sulfur dioxide is dissipated during cooking.

Labeling is required by the Federal Food and Drug Administration when sulfur dioxide or salts producing sulfur dioxide are used in foods destined for sale in interstate commerce. The use of sulfur dioxide is allowed by the Federal agency, provided the preservative is not added to conceal damage or inferiority. Several states, however, have additional restrictions on the use of sulfur dioxide.

There is a secret process for treating peeled potatoes. Although proponents of this secret treatment admit that it is more expensive than acidified bisulfite, they claim that it causes no off-taste, whereas high residual sulfur dioxide gives the product an off-flavor.

C. R. Havighorst (1) has given a detailed description of one type of mechanized line for processing pre-peeled potatoes. Because the integrated equipment described in this reference is one of the first lines developed for pre-peeled potatoes, it does not represent the latest in design and simplification. Equipment is available from several manufacturers for carrying out a synchronized process, including sorting the potatoes into various sizes, washing, continuous peeling, trimming along a conveyor belt, and treating with the solution to prevent discoloration.

After the color-stabilizing treatment, the potatoes are drained and sometimes exposed to a draft of air to remove excess surface water. They are then bagged and weighed. In these operations, automatic or semi-automatic equipment is used.

Packaging and Handling of Finished Product

To the best of our knowledge all pre-peeled potatoes produced at present are for restaurants, hotels, and institutions. Scattered attempts have been made to retail 1 to 2 pound packs in transparent or translucent film packages. Some processors feel that the item cannot be retailed profitably under present conditions.

Others believe a potential retail market exists far in excess of that now available in the restaurant and institution trade and awaits only the improvement of techniques to provide a surer and longer refrigerated storage life and an adequate campaign of consumer education.

Bags fabricated from cellophane, "Pliofilm,"* and polyethylene have been used in packaging pre-peeled potatoes in the retail merchandising

*Mention of products does not imply recommendation or endorsement by the United States Department of Agriculture over similar products not mentioned.

ventures. Several types of packaging are used in wholesale distribution of the product. Regardless of the type of packaging, there are apparently three guiding principles to be followed in handling peeled potatoes from the time they leave the treating bath until they are finally prepared for the table: 1. The potatoes should be kept cool, that is, in the temperature range of 32° to 40° F.; 2. although the potatoes are packed in air, the container should be fabricated of a material that is relatively impermeable to gases and it should be tightly closed to prevent the entry of additional air that would reduce the effectiveness of the treatment; 3. dehydration of the product should be avoided, since surface drying may adversely affect texture. Attention to the first and second conditions will go far toward insuring realization of the third.

Some processors put up an institution pack (35 pounds net weight) of peeled potatoes in wooden apple boxes lined with wax paper. Such containers are economical in that they can be re-used after the lining is replaced. It is difficult, however, to exclude air currents from the contents of such a package. Moreover, the sanitation problem is much more difficult when peeled potatoes are packed in re-usable containers than when "one trip" packaging is used.

Several processors put up 30- and 60-pound packs of peeled potatoes in polyethylene bags enclosed in 2-ply kraft paper bags. Others use heavy, multiple-wall paper bags for 30-pound packaging. The multiple-wall bags are comprised of the following components: A kraft outer layer; a 2-ply, thin kraft, asphalt-laminated center; and a white, high wet-strength inner liner. Still other processors employ a double-wall bag consisting of heavy kraft on the outside and a white, high wet-strength inner liner on the inside.

In sealing, film bags are usually closed with metal crimpers. Paper bags are closed by folding the top under and stapling.

Peeled potatoes are kept under refrigeration at the processing plant until delivery to the institution. Deliveries are made in insulated trucks that are either refrigerated or pre-cooled. The restaurateur refrigerates the product until it is used. Under normal conditions of distribution, pre-peeled potatoes are used within 1 week from the time of processing. High-quality potatoes, processed under favorable conditions and containing residual sulfur dioxide in the neighborhood of 100 parts per million, should be expected to remain in good condition for 1 week, including a short period in transit from processor to restaurant.

Lack of high standards of sanitation on the part of some processors constitutes a neglected phase in processing and handling of pre-peeled potatoes. Failure to conform to strict sanitary practices has undoubtedly caused the downfall of several processors in the industry. In cold weather, the careless processor may get by temporarily with sloppy methods of housekeeping and handling of the product, but in mild or warm weather such ignorance or neglect is certain to result in peeled potatoes of poor keeping quality.

"Par-Fried" Potatoes

Sliced potatoes for French frying in the "par-fried" form have recently been offered to the restaurant trade. Such sliced potatoes are not dipped in a treating solution but depend on the blanching action of hot oil to inactivate the enzyme system. Par-fried potatoes are potatoes fried

for several minutes in the processing plant to the point at which the slices start to brown. The slices are then drained, packaged similarly to uncooked peeled potatoes, and kept under refrigeration until ready for final preparation in the restaurant. In 1 to 2 minutes of final frying, par-fried potatoes are converted into French-fried potatoes of the usual moisture content and golden brown color.

Par-fried potatoes sell for approximately twice the price of uncooked peeled potatoes. The higher price is justified because they have a much lower moisture content than uncooked potatoes and contain appreciable fat. The fact that they can be quickly cooked to finished French-fried potatoes is also used as a selling point, since by this means they can be prepared rapidly on order and the demands during rush hours of restaurant operations can be met easily.

Little research has been carried out on packaging and marketing of raw peeled potatoes, particularly for retail sale. Research is needed to answer the following questions with respect to retail merchandising: (a) What type of packaging material is best? (b) Which size or sizes of package are preferred by consumers? (c) What type of peeled potato is most desired? (d) What price relationship and competition exists relative to other fresh and processed vegetables?

More general unknown points include the following: (a) Limitations of minimum and maximum sizes for economical operation of a central peeling plant; (b) maximum area that can be covered in servicing wholesale customers by trucks.

Summary and Conclusions

Restaurateurs now recognize the well-established pre-peeled potato industry as a good source of potatoes to fill all their needs except for baking. The present methods of preserving peeled potatoes against discoloration are adequate to meet the demands of the restaurant and institution trade. Such difficulties as keeping the product in good condition for the longer time required in retail merchandising, and adequately educating consumers concerning the product, are preventing the distribution of pre-peeled potatoes in consumer packs.

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